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Nutrition and Health

Overweight women shed more than excess fat when they follow a rigorous weight-loss regimen. After three months on such a regimen, 14 obese volunteers had significantly fewer problems with PMS-type mood swings, less antisocial or inefficient behaviors and better concentration. The women were given only half the calories they normally ate and were put on a strict aerobic exercise program. Their scores on a standard menstrual distress questionnaire were 40 percent below those given before they cut calories and began exercising. Also, their blood levels of monoamine oxidase dropped when they were dieting and exercising. This enzyme has been suggested as a factor in premenstrual tension. What's more, they lost about 36 pounds on average.

*Grand Forks Human Nutrition Research Center
Grand Forks, ND
James G. Penland, (701) 504-8932*

The fact that Americans eat more than reported in national databases was underscored in a new nutrition study. Other ARS researchers reported last year that volunteers in nutrition studies at Beltsville, MD, had underreported their caloric intake by an average 18 percent. In this study, researchers wanted to determine

how much zinc people absorb from typical U.S. diets, so they developed test meals based on the Food and Drug Administration's Total Diet Study. Twenty-eight men and women under age 40 consumed the 200 most commonly eaten foods in the amounts and proportions thought to represent the average intakes of men and women in their late 20s. The diets provided 2545 calories for the men and 1570 calories for the women. After two months, however, the men had lost nine pounds on average, and the women lost 11, even though researchers increased each food by 10 percent during the second month in an attempt to stem weight loss. They concluded that the FDA's Total Diet Study food lists do not provide the calories that adult men and women typically eat.

*Grand Forks Human Nutrition Research Center
Grand Forks, ND
Janet R. Hunt, (701) 795-8328*

Our diets may play a role in general aches and pains not related to an injury, infection or chronic illness, such as arthritis or migraine headaches. That's what an ARS researcher found when he analyzed patient records from eight separate nutrition studies for medications dispensed for such non-specific pain. The studies involved men, young women and women past menopause. In five of them, the live-in volunteers requested pain pills two to three times more frequently when their diets were most restrictive. Low copper intakes prompted significantly more requests from men and older women in three of the studies. In another study, young women took more medication when their diets were low in both calcium and manganese (not to be confused with magnesium). And a group of obese young women in a weight-loss study felt more pain when their calorie intake was cut in half. What's more, the young women in the latter two studies made almost as many requests for pain medication during the non-menstrual phase of their cycles as they did during menstruation. Women typically take a lot more pain medication when menstruating. This analysis is the first to show a link between diet and non-specific pain. The findings need to be repeated in future studies before any recommendations for dietary changes could be made.

*Grand Forks Human Nutrition Research Center
Grand Forks, ND
James G. Penland, (701) 795-8471*

It may be wise to boost the body's vitamin E reserves before beginning an exercise program. New findings suggest that the vitamin reduces some of the muscle damage that occurs during prolonged exercise by protecting cell membranes from oxidation. This helps preserve the cells' integrity. The findings also suggest that extra vitamin E reduces inflammation of damaged tissue, which can cause more damage. Researchers studied 21 sedentary men, half of whom took 800 I.U. of vitamin E daily for seven weeks prior to running downhill on a treadmill for 45 minutes. The other half got placebos. Each group consisted of young men in their twenties and older men between 55 and 74 years of age. By the twelfth day after exercise, the supplemented group—both young and older men—excreted significantly less of a by-product of fat oxidation. They also had significantly lower blood levels of two substances that trigger inflammation. Earlier studies at this ARS center suggest that the immune system responds to prolonged or muscle-damaging exercise much the same as it does to an infection—by launching an attack against damaged muscle tissue to clear it away for new tissue. But the inflammatory response may get out of control and damage healthy tissue as well.

*Human Nutrition Research Center on Aging at Tufts
Boston, MA*

Mohsen Meydani/Simin Meydani, (617) 556-3126/3129

Breast-feeding infants may be getting shortchanged on calories if their mothers smoke. ARS scientists found that mothers who smoke produced 22 percent less milk per day than non-smokers. Generally, there is a rapid increase in milk production two to four weeks after delivery. Smoking mothers in the study did not produce this increase. Also, their milk had low concentrations of fat. Infants need a high-fat diet, and 45 to 55 percent of the calories in breast milk come from fat. They could make up for the low calorie count by increasing their milk intake. But if milk production is also low, it may leave them nutritionally deficient. This may explain why smoking mothers wean their infants earlier than non-smokers.

*Children's Nutrition Research Center, Houston, TX
Judy M. Hopkinson, (713) 798-7008*

Farm animals that produce medicines and other useful products in their milk are a step closer to reality following the successful transfer of a gene into pigs. The gene for whey acidic protein, obtained from a researcher at the National Institutes of Health, switches on only when the sows are lactating, and they produce large amounts of the protein in their milk. The secret of this success is a "genetic switch" that is attached to the gene and turns on and off at lactation. To this switch, ARS researchers hope to attach genes for economically and medically important compounds and insert the

combination into milk animals such as cows and goats. Protein C, an anti-clotting drug used to treat heart attack victims, would be a candidate for the livestock "drug factories." And, a single goat, genetically engineered for blood-clotting factors could produce enough to treat all the world's hemophiliacs. Also, cows could be programmed to produce more milk casein—a protein necessary for cheese making. A 20 percent increase in casein would be worth \$200 million annually to U.S. cheese producers.

*Gene Evaluation and Mapping Lab, Beltsville, MD
Robert J. Wall, (301) 504-8362*

Copper deficiency interferes with the ability of rats' arteries to relax. This may explain why rats develop high blood pressure when fed diets devoid of copper, and it could have implications for people who consistently eat diets with very low copper levels. In the last decade, scientists have learned that cells lining the arteries are not passive. When stimulated by certain blood-borne chemicals, these cells release substances that cause the adjacent smooth muscle cells to either relax or contract. When the muscle cells are signaled to relax, blood pressure goes down. ARS researchers found that copper deficiency decreased the effectiveness of the relaxing factor in the aorta—the largest artery in humans and animals. In a second study, ARS and University of Louisville researchers saw the same response in smaller vessels, known as arterioles.

*Grand Forks Human Nutrition Research Center
Grand Forks, ND
Jack T. Saari, (701) 795-8499*

Growing concern about lead poisoning is prompting new interest in a fast, accurate and inexpensive test to measure soil lead that could enter the bloodstream of a child. Now, Cooperative Extension Service labs in Florida and Maryland have joined Illinois, Minnesota, Texas and Wisconsin in offering the test to homeowners for less than \$15. It was one of the tests used in a recently completed Environmental Protection Agency study of soil lead in Baltimore, Boston and Cincinnati. Unlike other costlier tests, the Chaney-Mielke test uses a mild solution of nitric acid. Shaking the soil in nitric acid approximates what happens to soil in a child's stomach where acidic gastric juices free lead from the soil, allowing it to move into the bloodstream. The test is being used by the U.S. Public Health Service and industries whose workers are exposed to lead contamination. Scientists at ARS and Xavier University in New Orleans developed the test more than 15 years ago.

*Environmental Chemistry Laboratory, Beltsville, MD
Rufus L. Chaney, (301) 504-8324
Xavier University, New Orleans, LA
Howard W. Mielke, (504) 486-7411*

Regardless of physical activity, older women's body composition appears to change with the seasons. In a study of 125 women past menopause, researchers detected significant increases in their muscle and bone mass after the summer-fall period and a significant decrease after the winter-spring period. But their weight remained the same during the year, and differences in physical activity did not appear to account for the changes. These seasonal ups and downs were seen in the women's arms and legs as well as their trunks. Conversely, fat tissue decreased in the summer-fall period and increased in the winter-spring period everywhere but in the arms. The more active women had the same degree of fluctuation in lean and fat tissue as the less active, suggesting that it may be influenced by seasonal changes in the activity of the brain's hypothalamus-pituitary area. This area regulates several major body hormones, such as the sex, growth, adrenal and thyroid hormones. The gains and losses did not quite cancel one another out, however: By the end of the year, the women had a net loss of muscle in their legs and a net gain of fat in their trunks.

*Human Nutrition Research Center on Aging at Tufts
Boston, MA
Bess Dawson-Hughes, (617) 556-3066*

Tomorrow's Foods

Three U.S. companies have been licensed to use an ARS-built gene to stop plant ripening. The gene has potential to reduce spoilage and aid marketing of fresher fruits, vegetables and ornamental cut flowers. All three companies—Calgene, Inc. of Davis, CA; DNA Plant Technology Corp. of Cinnaminson, NJ; and Monsanto Co. of St. Louis, MO—can use the gene to genetically engineer tomatoes. DNA Plant Technology has exclusive use of the gene in 16 other fruits and vegetables including banana, broccoli, cucumber, pepper, strawberry and watermelon, and seven ornamentals—carnation, chrysanthemum, geranium, gerbera, lily, poinsettia and rose. Monsanto Co. has rights to the gene's use in apple, avocado, nectarine, peach and pear. In ARS experiments, the gene blocked 99.5 percent of all production of a natural ripening gas, ethylene, in greenhouse-grown tomatoes. Later, scientists applied ethylene to the harvested tomatoes to allow them to ripen.

*Plant Gene Expression Center, Albany, CA
Athanasios Theologis, (510) 559-5900*

Several sweet and juicy Japanese plum varieties will be released soon to growers. From a Japanese plum bred with various American species, the new plums are being grown in test plantings in 11 southern states. They are far superior to commercially available southeastern

varieties in size, eating quality and disease resistance. Well suited for farmers seeking alternative income-producing crops in the southeastern United States, the new introductions are ideal for home gardeners.
*Southeastern Fruit and Tree Nut Research Lab
Byron, GA
William R. Okie, (912) 956-5656*

Vegetable crops are thriving under irrigation from waste water used to raise cold-water fish. Scientists harvested lettuce and strawberries from hydroponically grown plants fertilized with rainbow trout effluent. Quality was as good as that from conventionally grown plants. Plants treated with the trout effluent turned yellow, but an addition of iron corrected the problem. The effluent is deficient in iron, an element that fish don't need in high amounts. An added benefit of this system is a plant-based waste water treatment system to alleviate pollution generated by aquaculture facilities.
*Appalachian Fruit Research Station, Kearneysville, WV
Fumiomi Takeda, (304) 725-3451*

A plant now considered a troublesome weed—purslane—contains high levels of fatty acids, vitamin E and other nutrients, making it a prime candidate as a new vegetable crop. Studies show that a wild purslane species, *Portulaca oleracea*, contains more of one omega-3 fatty acid than any other green leafy vegetable to be studied to date. A 100-gram serving has about 300 to 400 milligrams of alpha-linolenic acid—10 times more than spinach. Omega-3 fatty acids have been linked in some studies to reduced heart disease and other health benefits, and are essential in building cell membranes, especially in the brain and eyes. Researchers also found that *P. oleracea* contains high levels of vitamin E—about 12.2 mg in a 100 g serving, six times more than spinach. Vitamin E protects cell membranes from breaking down. The plant is adaptable to dry conditions and to salty soils often present where land is irrigated. Its fleshy leaves, about the size of a fingernail, have a mild, nutty taste. There's already a market for the crop. Europeans eat it in their salads.
*Weed Science Lab, Beltsville, MD
Helen A. Norman, (301) 504-6471*

Oat plants have been genetically engineered for the first time, raising hopes that someday the plants may be redesigned to better resist diseases and produce more nutritious grain. ARS and University of Minnesota scientists bombarded oat embryo tissue culture with tiny tungsten particles coated with foreign DNA. The foreign DNA, used for experimental purposes only, included genes to produce an enzyme that allowed some oat tissue culture cells to resist an antibiotic. Also in the DNA were genes to produce another enzyme that made cells turn blue when treated with a test chemical. Scientists

subsequently confirmed the genes were present in seeds of plants grown from the tissue culture and in those plants' offspring.

Plant Science Research, St. Paul, MN
Howard W. Rines, (612) 625-5220

Food Freshness and Safety

A gout medication, allopurinol, stomps out cockroach populations in four to six weeks, ARS studies show. Allopurinol relieves gout pain by preventing a buildup of crystallized slivers of excess uric acid around a person's joints. In cockroaches, it prevents reproduction by depriving a cockroach mother of the uric acid she needs to form embryos in her eggs. Tests show that cockroaches eat rat chow laced with the drug just as heartily as they eat regular chow. Federal approval would be needed for allopurinol's use to control roaches. Several companies have expressed interest in commercializing the new technology.

*Medical and Veterinary Entomology Research Lab
Gainesville, FL*
Daniel R. Suiter, (904) 374-5910

Instead of aging beef up to 14 days to maximize tenderness, a shot of calcium chloride will do the trick in a mere 24 hours. Calcium chloride is found naturally in meat, and is approved by the Food Safety and Inspection Service as a meat additive. Meat becomes tender when calcium-dependent enzymes in muscle tissue are activated by calcium. An injection of calcium chloride, using a needle process, immediately following slaughter boosts the muscle calcium concentration in the meat. This activates the enzymes, called calpains, resulting in the same degree of tenderization in one day as normally occurs in 7 to 14 days of aging. Preliminary tests indicate the meat flavor is not affected; however, additional detailed tests are being conducted to assure the technique is not detrimental to flavor. Meat tenderized using this method would be labeled according to FSIS guidelines. This technique could help the beef industry ensure consumers will get consistently tender meat.

Meats Research Unit, Clay Center, NE
Mohammad Koohmaraie, (402) 762-4221

Ninety to 100 percent of corn earworm caterpillars succumbed to a new species of nematode—a microscopic worm that lives in the soil—in preliminary field tests. Named *Steinernema riobravis*, the nematode is likely to be the most effective earworm killer of its kind so far. Corn earworms cost U.S. corn farmers \$1.5 billion in damage and control each year. They are also known to growers as cotton bollworm, tomato fruitworm and soybean podworm because they attack many other crops besides corn. After nibbling on crops, the caterpillars

burrow into the soil and become pupae, the stage during which they transform to adult moths. *S. riobravis* nematodes wriggle inside a caterpillar or pupa and release bacteria that kill the pest within 48 hours. The nematodes then feed on the dead insect. Researchers mixed the nematodes in water and poured them on the field for the initial tests. For larger tests now underway, they applied the nematodes in irrigation water in furrows or sprinklers.

Subtropical Cotton Insects Research, Weslaco, TX
Jimmy R. Raulston, (512) 969-4807

A new strategy for immunizing chickens against chicken coccidiosis may come from their cousin—the turkey. When scientists fed chickens large doses of a coccidian parasite that normally attacks only turkeys, the birds developed immunity to the chicken version of the disease, which costs chicken farmers \$300 million annually. The chickens were fed about one million of the turkey parasites daily for about 10 days. Twelve days later they were infected with two economically important species of chicken coccidiosis—but they had the same rate of weight gain as control chickens, which had not been infected by either type of parasite. The scientists speculate that the turkey parasites produced a protein that caused a cross immunity to the chicken coccidiosis. If the scientists can determine what causes this cross immunity, it could lead to a vaccine for chicken coccidiosis.

Helminthic Diseases Laboratory, Beltsville, MD
Patricia C. Augustine, (301) 504-8428

A popular herbicide used to kill grassy weeds in soybeans and other crops is also environmentally friendly, a two-year field study has shown. Researchers wanted to know how the herbicide, sethoxydim, affected the environment in the soils and climate of the upper Midwest. About 27 percent of sethoxydim, as well as substances produced as the herbicide breaks down, remained in clay loam soil 20 days after application. That compared with about 68 percent of the herbicides atrazine and alachlor, not counting their breakdown products. After weeds were killed in late spring, much of sethoxydim was quickly destroyed by light and water, while some was consumed by microbes in the soil. Also, sethoxydim and its breakdown products leached more slowly through topsoil than did alachlor or atrazine. Sethoxydim is applied in very small amounts per acre—10 times less than atrazine and alachlor.

Soil and Water Management Research, St. Paul, MN
William C. Koskinen, (612) 625-4276